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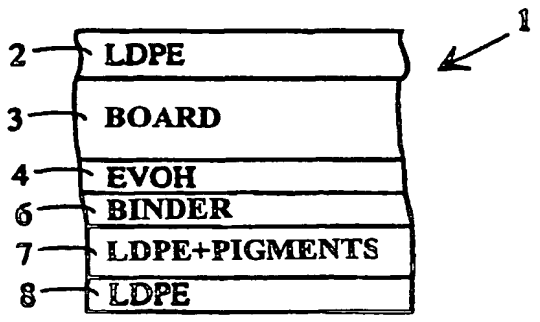
(54) Title: HEAT-SEALABLE PACKAGING MATERIAL AND A CLOSED PRODUCT PACKAGE MADE THEREOF



(57) Abstract: The invention relates to a heat-sealable packaging material and to a closed product package formed of such material especially for packaging foodstuffs. The packaging material (1) comprises a core layer (3) of paper or board and a polymer heat-sealing layers (2, 7, 8) on one side of the core layer or preferably on both sides of this. In accordance with the invention, two successive layers containing the same heat-sealable polymer have been disposed in the packaging material with pigment colouring the packaging material incorporated in the thicker, inner heat-sealing layer (7), while the thinner outer layer (8) is transparent. The inner layer (7) may contain light-shielding black pigment, such as carbon black, and also white pigment, such as titanium dioxide, so that the pigments together give the layer a grey tint. The grey layer (7) resembling an aluminium foil is placed inside the core layer (3) in the package. The heat-sealing polymer may consist of low-density polyethylene (LDPE), and polymer barrier layers may be incorporated in the material (1) to provide an oxygen, fat and aroma-proof material, e.g. an oxygen barrier layer (4) made of ethyl vinyl alcohol copolymer (EVOH).

Heat-sealable packaging material and a closed product package made thereof

The invention relates to a heat-sealable packaging material comprising a core layer of fibrous material and a polymer heat-sealing layer on at least one side of the core layer, the heat-sealing layer comprising at least one pigment colouring the packaging material. In addition, the invention relates to a closed product package formed of such packaging material by heat sealing, in which the pigmented polymer heat-sealing layer is located within the package.

By providing a fibre-based packaging material with a polymer coating layer that softens or melts under the action of heat, the material will be usable in product packages closed by heat sealing, such as package casings and containers. The package can be made liquid-proof by means of a heat-sealable polymer coating. Depending on the product, especially food packages are required to be oxygen and aroma-proof and to shield the product from light, and this aim is achieved by means of appropriately selected coating materials layered on a fibrous substrate.

In conventional procedures, a fibre-based packaging material has been provided with an aluminium foil, which yields a liquid, oxygen and aroma-proof package, while providing efficient protection from the penetration of visible light and UV radiation. Since, however, an aluminium foil is non biodegradable, thus making recycling difficult, and also a costly solution, it has been increasingly replaced with polymer coating materials, the chief materials among these being ethylene vinyl alcohol copolymer (EVOH), polyamide (PA) and polyethylene terephtalate (PET). By combining these polymers with binders and heat-sealing polymers, multi-layer boards have been achieved whose liquid, oxygen and aroma-barrier properties almost equal to those of aluminium.

As an example of prior art polymer-coated food package boards, we may cite FI layout print 96752. This publication discloses boards in which the fibrous substrate is coated on both sides with a heat-sealable polymer coating of e.g. low-density polyethylene LDPE or LLDPE, with an EVOH or PET barrier layer inserted between the fibre substrate and the heat-sealing layer.

Especially in food packages, it is recommended to use bleached sulphate pulp as the fibre substrate material, given the organoleptic properties of this material, which do not impart the packaged product significant odour or flavour flaws. With developments towards increasingly thin packaging materials, while aluminium foils have

been replaced with polymer coating layers, this has resulted in the drawback of increased light transmission of the packaging material. Light has proved to have a negative impact on the preservability and quality of many packaged foods.

US patent specification 4,513,050 describes packaging materials with a multi-layer coating, in which the polymer layer within the outermost heat-sealable polymer layer contains light-shielding pigments. JP Patent Application 6135439 discloses a polymer-coated packaging paper, in which the outermost coating layer forms a heat-sealing layer with a thickness of 30 to 150 μm and the pigmented layer within this forms a light-shielding layer.

US patent specification 4,576,865 describes a polymer-coated packaging paper, in which the outer coating layer acts as a heat-sealing layer and the inner, pigmented layer forms a light-shielding layer. In the applications included in the embodiment examples of the publication, light-shielding pigments have been incorporated also in the outer heat-sealing layer, and in this publication, also the inner pigmented layer contributes to light shielding. The essential feature in the publication is that the different layers are based on different polymers. Good neck-in, easy striping from the roll and non-sticking are the properties sought for the coating.

As a solution to the problem of light transmission, WO patent specification 01/76976 discloses mixing a light-absorbing pigment into the polymer heat-sealing layer of a packaging board. The publication describes especially packaging boards in which the heat-sealing layer forming the inner surface of the package has been coloured grey by blending carbon black and titanium dioxide that so that the coloured layer imitates the appearance of the aluminium foil inside a conventional package. This makes it considerably easier to make the solution acceptable in the market.

In the coated packaging board of WO 01/76976, the incorporation of colouring pigments specifically in a heat-sealing layer is due to the fact that blended pigments in the amounts used in the publication do not interfere with the heat sealability of the polymer. Added to an oxygen or aroma barrier layer, the pigments may deteriorate the barrier properties of the layer. In addition, a heat-sealable layer has the benefit of relative thickness compared to the barrier layers mentioned above; in a thicker layer, the pigment concentration may be lower and the pigments achieve regular, visually flawless covering.

In some countries, such as Japan, for instance, authority regulations do not permit that said pigments contact a packaged food. As a result of this, the packaging material in the applications described in the embodiment examples of WO 01/76976 cannot be marketed or used for food packages in these countries.

The purpose of the present invention is to find a solution to avoid the problem above caused by pigmented packaging materials. The fibre-based heat-sealable packaging material of the invention is characterised by the heat-sealing layer being formed in two parts, comprising an inner layer containing the colouring pigment, and an outer transparent layer forming the surface of the packaging material, both of said heat-sealable layers containing the same heat-sealable polymer, and the outer transparent layer having a weight of 5 to 20 g/m^2 and the inner pigmented layer having a thickness greater than that of the outer transparent layer.

Thus, the inventive idea is to maintain the colouring pigment or pigments of the packaging material in the polymer heat-sealing layer, while embedding them under the outer layer portion free from pigments so as to avoid contact with the packaged product. The heat-sealing polymer of this outer layer being colourless, it does not prevent the pigments contained in the inner layer from being visible and from determining the colour shade of the material. The outer heat-sealing layer is preferably relatively thin, while the inner pigmented heat-sealing layer has a thickness close to the conventional material thickness of the heat-sealing layer described in the WO reference mentioned above, so that the visual advantages of the previous solution, such as regular coverage by pigmenting, are maintained.

The successive heat-sealing layers of the packaging material of the invention containing the same heat-sealing polymer, the layer materials are mutually different only in the respect that the inner layer contains one or more colouring pigments evenly dispersed, whereas the outer layer is unpigmented. With successive heat-sealing layers based on the same polymer formed separately by co-extrusion, for instance, there will be no sticking problem between the layers. In the heat-sealing step, these layers will melt and both contribute to forming a seam, thus acting as one single integrated heat-sealing layer.

In accordance with the invention, the outer, unpigmented heat-sealing layer is formed with a smaller thickness than that of the inner pigmented layer. The minimum thickness of the outer layer depends on the available extrusion technique and on the ability of the polymer to form a continuous film. In accordance with the in-

vention, the outer, unpigmented heat-sealing layer may account for e.g. 10 to 40%, preferably 15 to 30% of the total thickness of the outer and the inner unpigmented heat-sealing layers. With heat-sealing layers made of extruded polyolefin, such as low-density polyethylene (LDPE), the weight of the outer, unpigmented heat-sealing layer may vary in the range from 5 to 20 g/m^2, preferably 7 to 15 g/m^2, and the weight of the inner, pigmented layer may be 25 to 70 g/m^2, preferably 30 to 45 g/m^2.

By adding a very small amount of black pigment, such as carbon black, to the heat-sealing polymer, visible light transmission of the packaging material is reduced almost to zero. The black pigment concentration in the inner heat-sealing layer may be in the range from 0.05 to 0.5 w%, more preferably 0.1 to 0.2 w% and most preferably 0.12 to 0.15%. If the layer is tinted grey by adding white pigment, such as titanium dioxide, the white pigment concentration in the inner heat-sealing layer may be 5 to 25 w%, preferably about 5 to 15% and most preferably 7 to 12%. Especially by blending 1.12 to 0.15 w% of carbon black and 7 to 12 w% of titanium dioxide with low-density polyethylene (LDPE), a heat-sealing composition is achieved, which, when applied to a board, looks so much like an aluminium foil that it could be mistaken as such.

In the packaging material of the invention, one side of the fibre substrate can remain uncoated if desired. Most preferably, the fibre substrate is nevertheless equipped with a polymer heat-sealing layer on both sides, preferably with the use of the same polymer in all of the heat-sealing layers. On the outside of the package, the coating layer may be colourless, i.e. free from pigment, thus not preventing visibility of prints on the package. On the other hand, the desired colour shade can be achieved by pigmenting also the outer surface of the package.

With low-density polyethylene (LDPE) applied in an adequately thick layer, a liquid-proof package can be achieved. In addition, the packaging material is made oxygen, fat and aroma-proof by inserting one or more polymer barrier layers between the fibre substrate and the heat-sealing layer, the barrier layers being made e.g. of ethylene vinyl alcohol polymer (EVOH), polyamide (PA), polyethylene terephtalate (PET) or a mixture of these.

The fibre-based product package sealed by heat sealing in accordance with the invention is characterised by the heat-sealing layer within the package being formed in two parts, so that it comprises a pigmented layer and a transparent layer insulat-

ing the pigmented layer from the packaged product and forming the inner surface of the package, with both of said heat-sealing layers containing the same heat-sealable polymer, and the weight of the transparent layer being 5 to 20 g/m^2 and the pigmented layer being thicker than the transparent layer. By mixing black and white pigments, e.g. carbon black and titanium dioxide, the inner surface of the package can be given a grey tint, so that it shields the packaged product from light and also resembles an aluminium foil. The package of the invention is preferably a package for perishable foodstuffs, such as a milk or juice container. The invention is also very useful in package casings without an inner bag for dry foodstuffs.

The packaging materials of the invention are explained more in detail below by means of examples and with reference to the accompanying drawings, in which figures 1 to 8 are schematic cross-sections of polymer-coated packaging boards of various embodiments of the invention.

Figure 1 illustrates a polymer-coated heat-sealable packaging material 1 of the invention in its most straightforward form. It is a coated packaging board, in which the core layer of fibrous material, i.e. the fibre substrate 3, is uncoated on one side and coated on the other side with two successive heat-sealing layers 7,8 of low-density polyethylene (LDPE). The inner layer 7 of these comprises one or more pigments, e.g. carbon black or titanium dioxide evenly dispersed in polymer, which together give the layer a grey tint, so that it resembles an aluminium foil. The outer LDPE layer 8 free from pigments is colourless, and hence does not cover the view of the inner grey-coloured layer 7.

The application of the packaging material 1 of the invention shown in figure 2 differs from that of figures 1 only in that a colourless heat-sealing layer 2 made of low-density polyethylene (LDPE) and free from pigments has been disposed on the opposite side of the fibre substrate 3.

The packaging material 1 of figure 3, again, differs from figure 1 in that an oxygen barrier layer 4 and a binder layer 6 made of ethylene vinyl alcohol copolymer (EVOH) have been placed between the fibre substrate 3 and the heat-sealing layers 7, 8 in order to bind the oxygen barrier layer to the heat-sealing layers. A suitable binder consists e.g. of low-density polyethylene modified with maleic anhydride.

Figure 4 shows a packaging material 1 suitable especially as package of liquid foodstuffs, such as dairy product or juice containers, which is a combination of the layer

structures of figures 2 and 3. The material 1 in figure 4 is layered in the following order: an LDPE heat-sealing layer 2, a fibre substrate 3, an EVOH barrier layer 4, a binder layer 6, a pigmented LDPE heat-sealing layer 7 and an unpigmented, transparent LDPE heat-sealing layer 8. With additions of black and white pigments to the inner heat-sealing layer 7, the material 1 will get a grey aspect resembling an aluminium foil. In the product package folded from the material and closed by heat sealing, the EVOH barrier layer 4 and the LDPE heat-sealing layers 7, 8 including their pigments will be located inside the package.

Figures 5 to 8 show variants of the packaging material 1 of figure 4. In figure 5, instead of EVOH, the material of the barrier layer 4 is polyethylene terephtalate (PET). In figure 6, again, the barrier layer 4 has been formed by blending polyamide (PA) into EVOH. Two adjacent barrier layers 4, 5 have been incorporated in the material of figure 7, the layer 4 closer to the fibre substrate 3 being made of polyamide and the outer layer 5 of EVOH. In the material o figure 8, the order of the barrier layers 4, 5 has been inversed; the inner layer closer to the fibre substrate 3 is an EVOH layer 4 and the outer is a PA layer 5. Like the material of figure 4, the materials of figures 5 to 8 are also suitable as liquid and oxygen-proof packages of especially liquid foodstuffs, which shield the product from light.

The preferred production technique for the polymer-coated packaging materials shown in figures 1 to 8 is co-extrusion, in which successive layers 4 to 8 are brought on top of the fibrous substrate 3 in one single step.

In all of the embodiments of the invention illustrated in figures 1 to 8, the fibrous substrate 3 of the packaging material 1 may preferably comprise a packaging board containing bleached sulphate pulp and having a weight of at least 130 to 500 g/m^2, preferably 170 to 300 g/m^2. The heat-sealing layer 2 forming the outer surface of the package, which is most preferably made of polyolefin, such as LDPE, may have a weight from 5 to 50 g/m^2, preferably 7 to 40 g/m^2. In each structure layer, the amounts of barrier layers 4, 5 and binder layers 6 may be 3 to 15 g/m^2, preferably 5 to 10 g/m^2. The weight of the inner pigmented heat-sealing layer 7 in the material 1 may be 25 to 70 g/m^2, preferably 30 to 45 g/m^2, and the outer, unpigmented heat-sealing layer 8 may have a weight of 5 to 20 g/m^2, preferably 7 to 15 g/m^2. The polymer material of these adjacent heat-sealing layers 7, 8 is most preferably the same as the polymer of the heat-sealing layer 2 forming the outer surface of the package. This polymer is most preferably LDPE. The pigments in the pigmented heat-sealing layer 7 may consist of carbon black in a concentration of 0.05 to 0.5%

in the layer, preferably about 0.12 to 0.15%, and titanium dioxide accordingly in a concentration of 5 to 25%, preferably about 7 to 12%.

The packaging material 1 of the invention, which has been exemplified above, can be produced as a continuous web punched to form blanks, which are further folded and heat-sealed to form closed food product packages. The heat-sealing temperature may be about 250°C or even more depending on the packaging efficiency. The products to be packaged are especially liquid foodstuffs, such as milk, cream, sour milk, yoghurt, ice cream and similar dairy products, juices, wine and water. The material is also suitable as a casing package of dry foodstuffs, such as flour, powders, flakes, cereals, crackers and animal food. The products may also be closed tins for prepared food, in which both the tin and the lid are made of the impermeable packaging material of the invention. The packages may be modified atmosphere packages (MAP) or packages sterilised by autoclave treatment.

The light-shielding properties of the layer toned grey with carbon black and titanium dioxide included in the packaging material and product package of the invention have been determined by measurements in the applicant's previous WO publication 01/76976 mentioned above, to which we refer in this context and which is incorporated by this reference in the description of the present application. These particular tests indicated that 75% of the ascorbic acid contained in the juice remained at the end of five weeks of storage owing to the light shield. In a product package otherwise identical, but devoid of light-shielding pigments, only about one third of the ascorbic acid remained at the end of five weeks of storage. Given the per se identical light shield of the material of the invention and the only difference from the previous measurements being that the pigmented layer is embedded into the material, it is obvious that the previous measurement results apply as such to the material and the packages of the present invention.

It is obvious to those skilled in the art that the different embodiments of the invention are not limited to those given as examples above, but may vary within the scope of the following claims. Thus, besides packaging boards, the packaging materials of the invention may be packing papers, in which the weight of the fibrous substrate is less than 130 g/m^2, most appropriately in the range from 40 to 120 g/m^2.

Claims

1. A heat-sealable packaging material (1), comprising a core layer (3) made of fibrous material and a polymer heat-sealing layer (2, 7, 8) at least on one side of the core layer, the heat-sealing layer containing at least one pigment colouring the packaging material, characterised in that the heat-sealing layer is formed in two parts so as to comprise an inner layer (7) containing the colouring pigment, and an outer transparent layer (8) forming the surface of the packaging material (1), both of said heat-sealable layers (7, 8) containing the same heat-sealing polymer, the outer transparent layer (8) having a weight from 5 to 20 g/m^2 and the inner pigmented layer (7) being thicker than the outer transparent layer (8).

2. A packaging material as defined in claim 1, characterised in that the heat-sealing layers (2, 7, 8) contain polyolefin, such as low-density polyethylene (LDPE).

3. A packaging material as defined in claim 1 or 2, characterised in that the outer heat-sealing layer (8) devoid of pigments accounts for 10 to 40%, preferably 15 to 30% of the total thickness of the outer and the inner heat-sealing layers (7, 8).

4. A packaging material as defined in any of the preceding claims, characterised in that the weight of the outer heat-sealing layer (8) devoid of pigments is 7 to 15 g/m^2.

5. A packaging material as defined in any of the preceding claims, characterised in that the weight of the inner, pigmented heat-sealing layer (7) is 25 to 70 g/m^2, preferably 30 to 45 g/m^2.

6. A packaging material as defined in any of the preceding claims, characterised in that the inner heat-sealing layer (7) comprises black pigment to shield the packaged product from visible light.

7. A packaging material as defined in claim 4, characterised in that the inner heat-sealing layer (7) contains a blend of black and white pigments to give the layer a grey tint.

8. A packaging material as defined in claim 7, characterised in that the inner heat-sealing layer (7) comprises a blend of carbon black and titanium dioxide.

9. A packaging material as defined in claim 7 or 8, characterised in that the in the inner heat-sealing layer (7), black pigment accounts for 0.05 to 0.5%, preferably 0.1 to 0.2% and most preferably 0.12 to 0.15% of the amount of polymer.

10. A packaging material as defined in claim 9, characterised in that the in the inner heat-sealing layer (7), white pigment accounts for 5 to 25%, preferably 5 to 15% and most preferably 7 to 12% of the amount of polymer.

11. A packaging material as defined in any of the preceding claims, characterised in being provided with polymer heat-sealing layers (2, 7, 8) on both sides of the core layer (3).

12. A packaging material as defined in any of the preceding claims, characterised in comprising additionally at least one gas-tight polymer barrier layer (4, 5) between the core layer (3) and the polymer heat-seal layer (7).

13. A packaging material as defined in claim 12, characterised in that the polymer material of the barrier layer (4, 5) is ethyl vinyl alcohol copolymer (EVOH), polyamide (PA) or a mixture of these.

14. A packaging material as defined in any of the preceding claims, characterised in that the core layer (3) is made of board containing bleached sulphate pulp.

15. A closed product package formed by heat sealing a packaging material (1) comprising a core layer (3) of fibrous material and a polymer heat-sealing layer (7) located within the package, the heat-sealing layer containing at least one pigment colouring the packaging material, characterised in that the heat-sealing layer within the package is formed in two parts, with a pigmented layer (7) and a transparent layer (8) insulating this pigmented layer from the packaged product and forming the inner surface of the package, both of said heat-sealable layers (7, 8) containing the same heat-sealable polymer, the weight of the transparent layer (8) being 5 to 20 g/m^2 and the pigmented layer (7) being thicker than the transparent layer (8).

16. A product package as defined in claim 15, characterised in that the pigmented heat-sealing layer (7) comprises a blend of black and white pigments, so that the light-absorbing black pigment shields the product from visible light and the black and the white pigment together give the inside of the package a grey tint.

17. A product package as defined in claim 16, characterised in that the heat-sealing layer (7) comprises a blend of carbon black and titanium dioxide.

18. A product package as defined in any of claims 15 to 17, characterised in that the outer surface of the package is also provided with a polymer heat-sealable coating layer (2).

19. A product package as defined in any of claims 15 to 18, characterised in that the packaging material additionally comprises at least one gas-tight polymer barrier layer (4, 5) between the core layer (3) and the polymer heat-sealing layer (7).

20. A product package as defined in any of claims 15 to 19, characterised in being a food package, such as a milk or juice container.

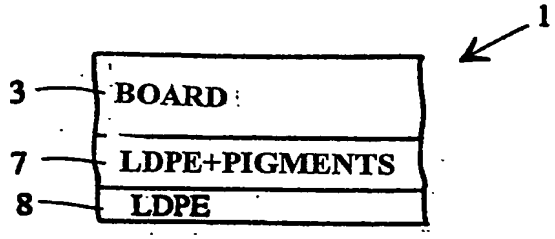


Fig. 1

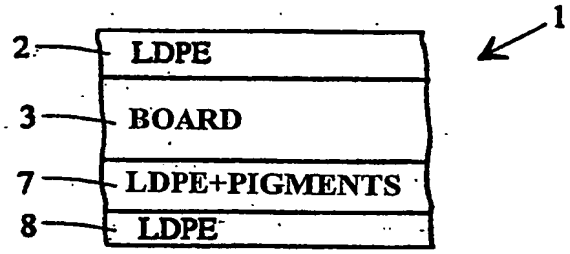


Fig. 2

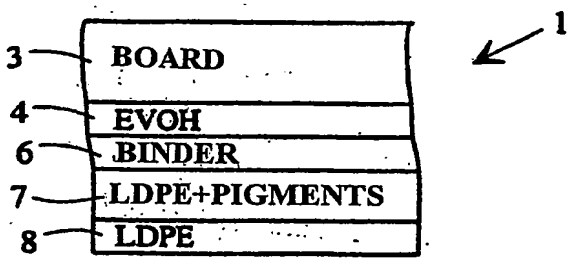


Fig. 3

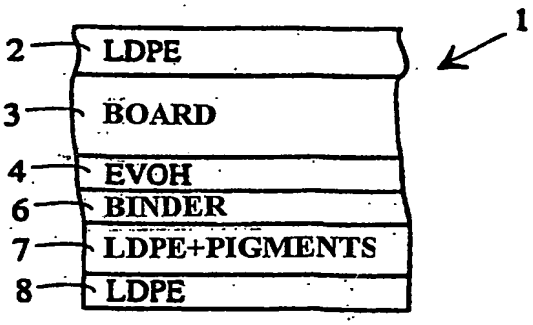


Fig. 4

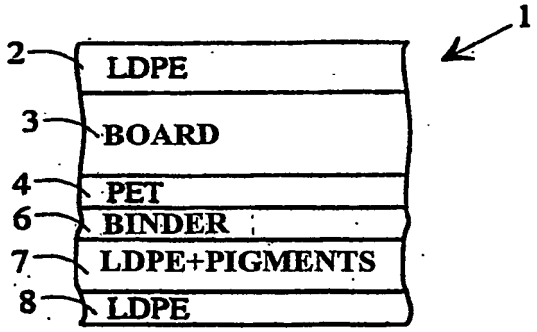


Fig. 5

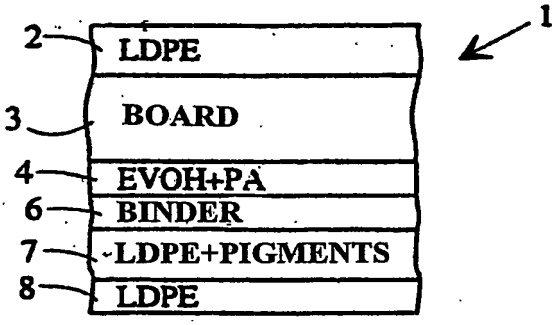


Fig. 6

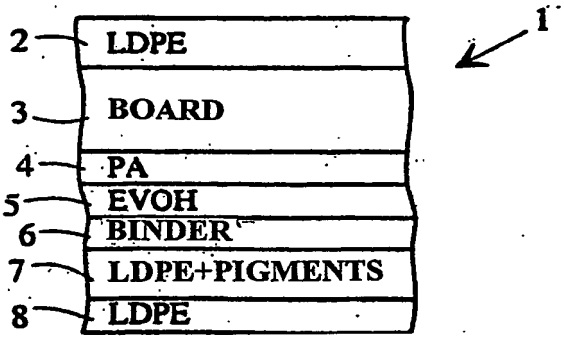


Fig. 7

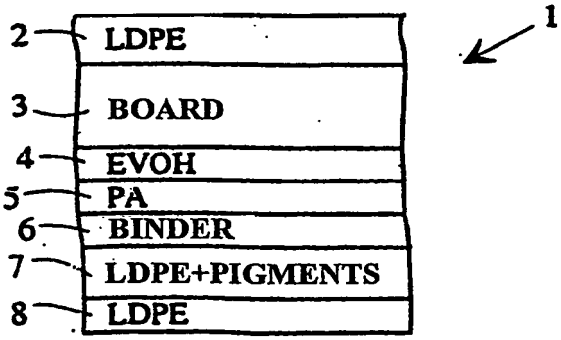


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 03/00555

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B32B 27/10, B32B 27/20, B32B 27/32, B65D 81/30
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B32B, B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 0176976 A1 (STORA ENSO OYJ), 18 October 2001 (18.10.01) --	1-20
X	WO 9702948 A1 (TETRA LAVAL HOLDINGS & FINANCE S.A.), 30 January 1997 (30.01.97), page 7, line 6 - line 15; page 8, line 6 - line 37 --	1-6,11-15, 18-20
X	PATENT ABSTRACTS OF JAPAN & JP 06-135439 A (DAINIPPON PRINTING CO LTD ET AL) 27 Oktober 1992 (1992-10-27) abstract --	1-6,11-15, 18-20

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer William Helin/Els Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

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PCT/FI 03/00555

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